Analysis of Contract-type and Acquisition Performance

Have fixed-price contracts resulted in superior acquisition outcomes?

Testing conventional wisdom

- Some believe that more use of fixed-price contracting will reduce cost and schedule growth rates on MDAP contracts
- If this is true, we would expect fixed-price contracts in the past to have experienced systematically lower cost growth and schedule growth rates, other things being equal (*ceteris paribus*)
- The hypothesized predictor is: an indicator variable (i.e. “dummy variable”) for fixed-price contracts
- But, we must control for effects of other significant predictors as well

The data for development contracts

- There were 433 contracts in the sample
- Break-down by contract-type:
  - 74 CPIF
  - 108 CPAF
  - 100 CPFF
  - 78 fixed-price
  - 73 hybrid (mixture of CLIN contract types)
- DoD performance data for large MDAP contracts from January 1970 through December 2011
- All data not adjusted for inflation (then-year)

The data for early production contracts

- There were 440 contracts in the sample
- Break-down by contract-type:
  - 23 CPIF
  - 16 CPAF
  - 48 CPFF
  - 293 fixed-price
  - 60 hybrid (mixture of CLIN contract types)
- DoD performance data for large MDAP contracts from January 1970 through December 2011
- All data not adjusted for inflation (then-year)

Data methodology

- Collected performance data by contract as recorded in DAMIR segregated by
  - Development (433)
  - Early production (440)
- Converted data into comparable metrics
  - Percentage cost growth as difference between final reported PM's EAC and initial baseline (initial CBB)
  - Percentage schedule growth as difference between final schedule and initial baseline schedule
  - Percentage scope growth as difference between final reported CBB and initial baseline (initial CBB)
  - Appropriate indicator ("dummy") variables

Sample development contracts characteristics

- Sample cost growth characteristics
  - Average cost growth: 75%
  - Median cost growth: 33%
  - Minimum cost growth: -61%
  - Maximum cost growth: 1221%
  - Only 6.7% of contracts had negative cost growth
- Sample schedule characteristics
  - Average schedule growth: 32%
  - Median schedule growth: 14%
  - Minimum schedule growth: -49%
  - Maximum schedule growth: 582%
  - Only 5.8% of contracts had negative schedule growth
- Duration of contract
  - Average: 6.7 years
  - Median: 6.2 years

Sample early production contracts characteristics

- Sample cost growth characteristics
  - Average cost growth: 46%
  - Median cost growth: 11%
  - Minimum cost growth: -46%
  - Maximum cost growth: 677%
  - Only 21% of contracts had negative cost growth
- Sample schedule characteristics
  - Average schedule growth: 30%
  - Median schedule growth: 11%
  - Minimum schedule growth: -34%
  - Maximum schedule growth: 691%
  - Only 7% of contracts had negative schedule growth
- Duration of contract
  - Average: 5.2 years
  - Median: 4.6 years

Specific analysis methodology

- Regressed outputs on inputs or likely predictors of selected outputs
- Did regression diagnostics
- Did sample analysis using standard robust non-parametric sample tests
- Ran bootstrap simulations (1000) on all regressions to obtain
  - Unbiased coefficient estimates
  - Correct standard errors
  - Correct confidence intervals

Development regression

- Modeled total cost growth as a function of
  - Scope growth
  - Aircraft indicator
  - UCA indicator
  - Indicator for fixed-price contract-type
    - IF more fixed-price contracting would have improved performance, expect the coefficient estimate to be negative and significant
  - A constant

Early production regression

- Modeled total cost growth as a function of
  - Scope growth
  - Schedule growth
  - Indicator for an Army contract
  - Indicator for fixed-price contract-type
    - IF more fixed-price contracting would have improved performance, expect the coefficient estimate to be negative and significant
  - A constant

Results of analysis of cost growth in development phase

Variable	Coefficient (Standard error)	Significant at 5% Level of Signicance?
Percentage growth in work content of contract	1.025 (0.0200)	Yes
Indicator for aircraft contract	0.230 (0.0612)	Yes
Indicator for UCA	0.0791 (0.0348)	Yes
Indicator for **fixed price contract-type**	0.0698 (0.0447)	No
Constant	0.0999 (0.0245)	Yes
Model p-value	0.0000***	
Coefficient of determination	0.939	
Adjusted coefficient of determination	0.939	

Results of analysis of cost growth in early production phase

Variable	Coefficient (Standard error)	Significant at 5% Level of Signicance?
Percentage growth in work content of contract	1.07 (0.0304)	Yes
Schedule growth rate	0.0949 (0.0327)	Yes
Indicator for Army	0.124 (0.0458)	Yes
Indicator for **fixed price contract-type**	0.0340 (0.0313)	No
Constant	0.0270 (0.0256)	No
Model p-value	0.0000***	
Coefficient of determination	0.922	
Adjusted coefficient of determination	0.922	

Results of non-parametric tests of development contract sample

- No significant difference between fixed-price and cost-reimbursable contracts with respect to total cost growth
- No significant difference between fixed-price and cost-reimbursable contracts with respect to schedule growth
- Level of significance used in analysis: 5%

Results of non-parametric tests of early production contract sample

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- Level of significance used in analysis: 5%

Results of analysis of development regression

- Regression explains 94% of variation in the data
- Other things being equal
  - A 1 percentage point increase in scope growth predicts a 1.025 percentage point increase in total cost growth
  - Aircraft contracts generally experience 23% higher cost growth than other commodity contracts
  - Contracts with a UCA generally experience 8% higher cost growth than contracts not experiencing a UCA
  - There was no significant difference noted between the cost performance of fixed-price contracts and cost-reimbursable contracts
  - All hypotheses were tested at the 5% level of significance

Results of analysis of early production regression

- Regression explains 92% of variation in the data
- Other things being equal
  - A 1 percentage point increase in scope growth predicts a 1.07 percentage point increase in total cost growth
  - A 1 percentage point increase in schedule growth predicts a 0.095 percentage point increase in total cost growth
  - Army contracts generally experience 12% higher cost growth than the other two services
  - There was no significant difference noted between the cost performance of fixed-price contracts and cost-reimbursable contracts
  - All hypotheses were tested at the 5% level of significance

Conclusions

- In general, managers have correctly selected contract-type for large development contracts for MDAP programs
- In general, managers have correctly selected contract-type for large early production contracts for MDAP programs

Backups

Results of diagnostics run on OLS regression of development contracts sample

- Test of normality of residuals
  - Smirnov- Kolmogorov test: Residuals are non-normal
  - Shapiro- Wilk test: Residuals are non-normal
- Cook- Weisberg test for heteroskedasticity: Heteroskedasticity is a problem
- Variance inflation factor (VIF) test: Multicolinearity is not a problem
- Ramsey RESET omitted variable test: Model has no omitted variables
- Linktest: model is correctly specified

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Non-parametric tests used on samples

- Wilcoxon rank-sum test
- Kolmogorov- Smirnov test
- Median test